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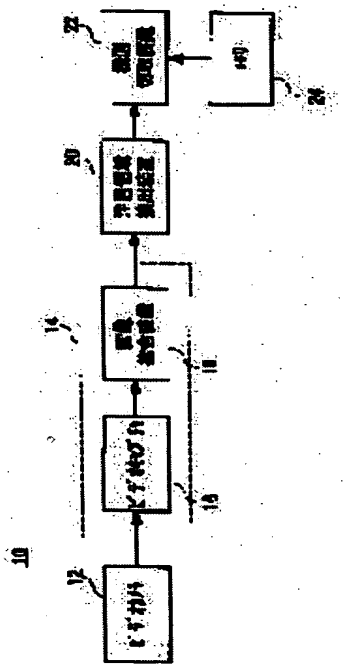
(54) NOTICING AREA EXTRACTING DEVICE AND AUTOMATIC COMPOSITION DECIDING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To extract a noticing area adjusted to human subjectively and to automatically device well-balanced composition.

SOLUTION: A noticing area extracting device and an automatic composition deciding device 10 include an image forming device 14, which generates the original image of a panoramic image from video photographed by a camera 12. A noticing area extracting device 20 extracts a noticing area from the original image given from the device 14. Namely, evaluation matched with human subjectivity is given in accordance with the physical feature of the original image and the noticing area is extracted in accordance with the evaluated result. A composition cutting off device 22 cuts out the extracted noticing area and an adjacent image area from the original image by referring to data on paintings painted by painters and photographs taken by photographers stored in a memory 24. Namely, the data can be cut out by the same composition as the case with painted images or photographed images.



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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the attention field extractor cut out from a subject-copy image so that the composition of a picture that experts, such as a painter and a photographer, made the attention field which extracted and extracted the attention field may be suited and it may be especially settled, for example from a subject-copy image about the automatic composition decision equipment which used an attention field extractor and it, and the automatic composition decision equipment using it.
[0002] Here, the field where people observe an attention field in an image or an image is said.
[0003]
[Description of the Prior Art] As this kind of conventional technology, various methods are proposed about the technique to which a watcher extracts an attention field from an image. (1) Milanese and Itti And Koch and others assumes the discontinuous part in an image to be an attention field, and generates the feature map (shade image) corresponding to two or more physical features acquired from an image, next asks for the discontinuous part of each feature map, and is extracting as an attention field what unified them.
[0004] (2) Milanese and others filtered the feature map using two or more Difference-of-ofiented-Gaussians filters with which magnitude was fixed in the discontinuous part of each feature map, and chose and searched for the filtering result from which an output serves as max. Itti, Koch and others normalized each feature map with the square error with each average, and unified all the feature maps by linear combination. And the integrated feature map was recursively filtered with the Difference of Gaussian filter, and the local peak of the filtering result finally obtained was extracted as an attention field.
[0005] Thus, Milanese, Itti and others were extracting the attention field by processing of pixel level, such as filtering and relaxation.
[0006] (3) Martin, Takeuchi and others evaluated the brightness information acquired from an image based on the information theory of Shannon, and made the attention field the portion with the high amount of information acquired as a result. By this method, the field, i.e., the field which looks complicated, where distribution is large and the bright field of a brightness value are mainly extracted.
[0007] Moreover, with the conventional camera, human being had determined the composition of a photographic subject and a photographic subject manually.
[0008]
[Problem(s) to be Solved by the Invention] However, since attention area size changed with images by the technique of of (1) and (2), it was difficult to extract an attention field exactly using the filter with which magnitude was fixed. Moreover, in the case of the picture which cannot not necessarily be said to be in agreement [the field which looks complicated, or a bright field] with an attention field like the black picture of a flower vase placed, for example in front of the wall of a complicated pattern by the technique of (3), it was difficult to extract an attention field exactly. Furthermore, by such proposal,

there were few examples which performed collating with a watcher's (human being) subjectivity and an extract result, and it was a question whether the attention field which actually suits human being's subjectivity can be extracted.
[0009] Moreover, with the conventional camera, when ordinary men without the sense over a photograph determine composition, the good photograph of balance cannot necessarily be taken.
[0010] So, the main purpose of this invention is offering the attention field extractor which can extract exactly the attention field which suited human being's subjectivity.
[0011] Moreover, other purposes of this invention are offering the automatic composition decision equipment which can determine the good composition of balance automatically.
[0012]
[Means for Solving the Problem] The 1st invention is an attention field extractor which extracts an attention field from a subject-copy image, and is an attention field extractor equipped with an evaluation means to evaluate the degree of [**] based on the physical feature (whenever for it to be conspicuous), and an extract means to extract an attention field according to an evaluation result of an evaluation means.
[0013] The 2nd invention is automatic composition decision equipment which used an attention field extractor of a publication for the 1st invention, and is automatic composition decision equipment equipped with a maintenance means to hold data about a criteria image which has criteria composition, and a cutoff means which cuts out an image of an attention field from a subject-copy image with reference to criteria composition.
[0014]
[Function] An evaluation means evaluates the degree of [**] by the attention field extractor of the 1st invention according to the physical feature of a subject-copy image. Here, the degree of [**] means the parameter suitable for human being's subjectivity. An extract means extracts a most conspicuous field from an evaluation result as an attention field. That is, since an evaluation means carries out evaluation which suited human being's subjectivity according to the physical feature, the attention field which suited human being's subjectivity can be extracted.
[0015] For example, when the physical feature includes whenever [of a color / heterogeneous], the degree of [**] can be evaluated based on the difference in the color of each field.
[0016] Moreover, since it includes [formal] whenever [of a texture (pattern) / heterogeneous] further whenever [of area] heterogeneous [, and] and whenever the color of the physical feature is heterogeneous in addition, if the degree of [**] is evaluated based on whenever [whenever / these / four / heterogeneous / at least one / heterogeneous], according to the feature of a subject-copy image, the degree of [**] can be evaluated exactly.
[0017] Moreover, if it is the case where it evaluates also about three elements (a hue, saturation, lightness) of a color, the field near the conspicuous color (red) by human being's subjectivity can be estimated as a most conspicuous field.
[0018] Furthermore, if it evaluates also about the area of each field in spatial frequency or a subject-copy image, most conspicuous evaluation of a field can be judged still more exactly.
[0019] Moreover, the image corresponding to the image which photoed the desired image with the photography means, for example, was photoed can be compounded, and a subject-copy image can also be generated.
[0020] For example, if the location and height of a camera which are contained in a photography means are fixed, 360 degrees rotates and it enables it to take a photograph, when a cementation means joins the image in every frame, the subject-copy image of a panorama image is generable within the limits of 360 degrees.
[0021] With the automatic composition decision equipment of the 2nd invention, a maintenance means uses as a criteria image the pictures image and photograph corresponding to the photograph which the pictures which the painter drew, and a photographer took, and the data about this criteria image is held. Since a cutoff means cuts out the image of an attention field from a subject-copy image with reference to the data about this criteria image, it can determine the good composition of balance automatically.

[0022] Moreover, if the data about two or more criteria images is held, since a selection means can choose the composition suitable for the image of an attention field, the good composition of balance can be determined about all images.
[0023] Since the data about the above criteria images contains the image data corresponding to a criteria image, the configuration data of a photographic subject, and the location data of a photographic subject at least, it chooses the composition suitable for an attention field, and can determine the good composition of balance automatically. That is, a photograph as if it photoed the photographic subject in the composition is generable.
[0024]
[Effect of the Invention] Since an attention field is extracted according to the evaluation result of the physical feature suitable for human being's subjectivity according to this invention, the attention field which suited human being's subjectivity can be extracted.
[0025] According to other invention, since an attention field is cut out from a subject-copy image using the criteria composition of a criteria image, the good composition of balance can be determined automatically.
[0026] The above-mentioned purpose of this invention, the other purposes, the feature, and an advantage will become still clearer from the detailed explanation of the following examples given with reference to a drawing.
[0027]
[Example] With reference to drawing 1 , the automatic composition decision equipment 10 of this example contains a video camera (only henceforth a "camera") 12. A camera station (a location and height) is fixed using a tripod etc., 360 degrees of cameras 12 rotate and they can be photoed. The image photoed with the camera 12 is inputted into image generation equipment 14, and the panorama image as a subject-copy image is generated from the photoed image. In addition, since 360 degrees of cameras 12 can be rotated, image generation equipment 14 can generate a panorama image within the limits of 360 degrees.
[0028] Image generation equipment 14 generates a panorama image according to flow drawing shown in drawing 2 including video capture 16 and image cementation equipment 18. That is, if photography is started with a camera 12, after image generation equipment 14 starts processing, is step S1, carries out the capture of the first video frame (the 1st frame) using video capture 16 and generates a synthetic image from the image corresponding to oneth of them, it will generate a gray-scale image from the synthetic image using image cementation equipment 18.
[0029] At continuing step S3, the capture of the following frame is carried out and a gray-scale image is generated like the 1st frame. At step S5, in order to determine from which location the synthetic image corresponding to the present frame (object frame) should be compounded, a retrieval template is started from the gray-scale image of an object frame as shown in drawing 3 . The width of face of this retrieval template is 50 pixels, and that height is the same as a frame image. Moreover, this retrieval plate is cut down from the zero of an object frame.
[0030] Then, at step S7, a retrieval range is set up from the gray-scale image of a synthetic image, and the image of the same magnitude as a retrieval template is cut down from a retrieval range. That is, the width of face of a retrieval range is 100 pixels, and the height is the same as a frame image. Moreover, when the upper left of a frame image is made into a zero (x y) (= (1 1)), the x-coordinate of a retrieval plate is the location which subtracted only 100 from the width of face of a frame image, and the y-coordinate is 1.
[0031] Next, in step S9, from a retrieval range, the image of the same magnitude as a retrieval template is cut down, and the absolute value of the difference of the mutual pixel value corresponding to the image and retrieval plate which were cut down is computed. At continuing step S11, it judges whether the difference of a pixel value is minimum (0). If it is "YES" at step S11, the cut-down image will judge that it is the same magnitude as a retrieval plate, and will progress to step S13. On the other hand, if it is "NO" at step S11, after judging that the magnitude of the image and retrieval plate which were cut down differs and shifting the retrieval range of 1 pixel to the positive direction of a x axis at step S15, it will

return to step S5. Thus, processing is repeated until the image and retrieval template which were started become the same magnitude, shifting 1 pixel at a time.
[0032] At step S13, X coordinate in case the absolute value of a difference is minimum (0) is computed. Continuing step S17 generates superposition and a new synthetic image for a synthetic image and an object frame image by the computed X coordinate. And at step S19, it judges whether the gray-scale image was generated from the generated synthetic image, and the panorama image was generated at step S21. If the panorama image will not be generated if it is "NO" at step S21 that is, it returns to step S3. On the other hand, if it is "YES" at step S21, it will judge that the panorama image (subject-copy image) as shown in drawing 4 (A) was generated, a subject-copy image will be outputted to the latter attention field extractor 20 (drawing 1) at step S23, and processing will be ended.
[0033] Returning to drawing 1 , the attention field extractor 20 extracts a most conspicuous field (attention field) from the given subject-copy image. Specifically, the attention field extractor 20 processes according to flow drawing shown in drawing 5 . That is, if a subject-copy image is given from image generation equipment 14, the attention field extractor 20 will start processing and will carry out field division of the subject-copy image at step S31. As shown in drawing 4 (B), specifically, a subject-copy image is divided into a drawing field and a picture field. the method of this field division -- 1997IEEE -- setting -- W.Y.Ma and B.S.Manjunath ** -- the boundary detection method based on "edge flow" indicated to "Edge Flow:A Framework of Boundary Detection and Image Segmentation" is applied. If it explains briefly, this method is edge flow which searches for the change direction of a color or a pattern in each location of an image, and consists of (size) in the strength of the change direction and change. A vector is determined. And it is edge flow by repetitive operation. A vector is spread in the direction of each vector, and the location where final vectors collide is made into the boundary line of each field.
[0034] Therefore, the divided drawing field as shown in drawing 4 (C) is extracted, and step S33 estimates the degree of a drawing field of [**] at step S35. That is, it asks for the degree parameter of a drawing field of [**]. Here, the subjectivity evaluation experiment which the artificer conducted showed that the physical features required for evaluation of the degree of [**] were [of a texture] a color, spatial frequency, and area whenever [formal] heterogeneous, and whenever [of area] heterogeneous [, and] whenever [of a color] heterogeneous. Moreover, generally, since the relation between human being's subjectivity evaluation result and a physical characteristic is expressed with a serpentine curve in many cases, an one ****** evening function is used for evaluation which is the degree of [**] several 1.
[0035]
[Equation 1]
$$H(m, n) = \int_0^1 h^{m-1}(1-h^{n-1})\,dh$$

[0036] The performance index of the degree of [**] as shown in several 2 is defined using this beta function.
[0037]
[Equation 2]

$$A_{i,t} = \int_0^1 a_{i,t}^{m-1}(1-a_{i,t}^{n-1})\,da_{i,t}$$

$$a_i = HET_i + FP_{i,t}$$

ただし、

$A_{i,t}$: 領域iの時間tにおける誘目度
$a_{i,t}$: 領域iの時間tにおける特徴量統合値
HET_i : 領域iの異質性誘目度
$FP_{i,t}$: 領域iの時間tにおける特徴誘目度
i : 領域i
t : 時間
m, n : 立ち上がり，飽和パラメータ

[0038] Moreover, whenever [above-mentioned of each field shown in several 2 / four] heterogeneous, the degree HET of [**] is defined by several 3.
[0039]
[Equation 3]
$$HET_i = wh_1 \cdot HC_i + wh_2 \cdot HT_i + wh_3 \cdot HS_i + wh_4 \cdot HSh_i$$

ただし、

HET_i : 領域iの異質性誘目度
HC_i : 領域iの色の異質度
HT_i : 領域iのテクスチャの異質度
HS_i : 領域iの面積の異質度
HSh_i : 領域iの形の異質度
wh_i : 重み係数

[0040] Furthermore, whenever [of each physical feature] heterogeneous, H is computed according to several 4, when standard deviation of dm and Difference d is set [the difference of the feature value and the average feature value of all fields] to std for the average of d and Difference d.
[0041]
[Equation 4]
$$H(d, dm, std) = \left|\frac{d-dm}{std}\right|$$

[0042] That is, HC is CIE whenever [of the color of each field] heterogeneous. L* a* b* The result of having computed and computed the color difference of the average color of a field and the average color of all fields, a color difference average, and the standard deviation of the color difference using the color difference type in perception uniform color space is substituted for several 4, and it asks. In addition, the color difference type is indicated by 1994 "a color science handbook" at details. Specifically, it is the color information on each pixel of an image (R, G, B) Equal perceived-color-space L* a* b* It changes and Euclidean distance in the space is made into the color difference. That is, a color difference type is shown like several 5.
[0043]
[Equation 5]
$$\Delta Eab^* = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)]^{\frac{1}{2}}$$

[0044] Next, HT is explained whenever [of a texture] heterogeneous. a texture -- 1996IEEE -- setting --

B.S.Manjunath W.Y.Ma ** -- it is expressed by the textural facility vector indicated to "Texture Features for Browsing and Retrieval of Image Data", and the difference between textures is expressed by the Euclidean distance between textural facility vectors.
[0045] Here, a textural facility vector is expressed by the vector which uses as an element the response when filtering an image by the Gabor filter bank constituted from two or more Gabor filters with which magnitude differs from a direction. However, since there is no orthogonality in each response when it filters with two or more Gabor filters, redundant information may be included in the filtered result. Then, the parameter of each filter in the Gabor filter bank is determined by the technique indicated by above-mentioned 1996IEEE. Specifically, it asks for theta, a, mhou, and mhov of the Gabor filter shown by several 6 by several 7. In addition, for this technique, the filter which adjoins as shown in drawing 6 is Half-Peak. In order to determine that the scale (magnitude) and bearing parameter of a filter touch and to express a textural facility, 24 filters (four scales, six directions) are used.
[0046]
[Equation 6]

$$G_{mn}(x, y) = a^{-m} \cdot G(x', y')$$

$$G(x, y) = \left(\frac{1}{2\pi\sigma_x\sigma_y}\right) \exp\left[-\frac{1}{2}\left(\frac{x^2}{\sigma_x^2} + \frac{y^2}{\sigma_y^2}\right)\right] \cdot \exp(2\pi jUx)$$

$$U = a^{m}$$

$$x' = x\cos\theta + y\sin\theta$$

$$y' = -x\sin\theta + y\cos\theta$$

$$\sigma_x = \frac{1}{2\pi\sigma_u}$$

$$\sigma_y = \frac{1}{2\pi\sigma_v}$$

ただし、

Gmn(x, y) : スケールID=m, 方位ID=nの時のガボールフィルタ
m : 0 .. S-1
n : 0 .. K-1
S : スケール数
K : 方位数

[0047]
[Equation 7]

$$\theta = \frac{n\pi}{K}$$

$$a = (U_h/U_l)^{\frac{1}{K+1}}$$

$$\sigma_u = \frac{(a-1)U}{(a+1)\sqrt{2\ln 2}}$$

$$\sigma_v = \tan\left(\frac{\pi}{2k}\right)\left[U_h - 2\ln 2\left(\frac{\sigma_u^2}{U_h}\right)\right]\left[2\ln 2 - \frac{(2\ln 2)^2\sigma_u^2}{U_h^2}\right]^{\frac{1}{2}}$$

ただし、

Uh: ガボールフィルタバンクの最大中心周波数
Ul: ガボールフィルタバンクの最小中心周波数

[0048] A textural facility vector is expressed by this several 6. Therefore, whenever [of the texture of each field] heterogeneous, HT is computed by substituting the average of distance with the mean vector of all fields, and distance, and the standard deviation of distance for several 4.
[0049] Furthermore, whenever [of the area of each field] heterogeneous, HS is computed by substituting the average of a difference with the average area of all fields, and a difference, and the standard deviation of a difference for several 4.
[0050] In whenever [of the appearance of a field / heterogeneous], and, whenever [of the hole which a field includes / heterogeneous], whenever [of the form of each field] heterogeneous, it unifies and HSh is obtained further again, as shown in several 8.
[0051]
[Equation 8]

$$HSh_i = \frac{SHD_i + HOD_i}{2}$$

ただし、

HSh_i: 領域iの形の異質度
SHD_i: 領域iの外形の異質度
HOD_i: 領域iの穴の異質度

[0052] It is necessary to be because for a graphic form to be rotated, to be visible, and to consider both differences of the direction as the difference in the configuration itself about the difference in a form, here. Then, a configuration can be described using the P type fourier descriptor which Yoshinori Kamisaka indicated to "the new fourier descriptor applicable also to an open curve" in 1984/3 "an institute-of-telecommunications-engineers paper magazine." In this case, if the power to each frequency after the P type Fourier transform is detected, power is in agreement when the configuration of two graphic forms is the same. Moreover, if the fourier descriptor is used, it restricts to the time when a configuration and an angle of rotation are in agreement, and the fourier descriptor is in agreement. Therefore, the fourier descriptor and the power to each frequency can estimate how many configurations and appearance of two graphic forms are in agreement.
[0053] As mentioned above, the feature of an appearance can be expressed by the vector which consists of Fourier coefficients and power, and the difference of an appearance can be expressed using the Euclidean distance between these feature vectors. Therefore, whenever [of the appearance of each field] heterogeneous, HSh is computed by substituting the average of distance with the mean vector of all fields, and distance, and the standard deviation of distance for several 4.
[0054] Next, Hho is explained whenever [of a hole] heterogeneous. In order to express the feature of

the hole which a field includes, it is necessary to take into consideration not only the configuration of a hole but the number and hole site of a hole. Asking for the primary moment of a field can define the difference in a hole site. In addition, the primary moment is indicated by 1992 "an image-analysis handbook." Therefore, the feature of a hole was expressed by the vector as shown in several 9. In addition, sequence of a hole is made into the order near the zero of an image.

[0055]

[Equation 9]

$$ho=[nh, M, ha_{1,1}, \cdots, ha_{1,n}, hb_{2,1}, \cdots, hb_{2,n}, \cdots, ha_{m,1}, \cdots, ha_{m,n}, hb_{m,1}, \cdots, hb_{m,n}]$$

ただし、

ho : 穴の形の特徴ベクトル
nh_i : 領域iの穴の数
M_i : 領域iのモーメント
$ha_{i,1,j}$: 領域iの1番目の穴のj次のフーリエ係数
$hb_{i,1,j}$: 領域iの1番目の穴のj次のパワー

[0056] Therefore, whenever [of the hole of each field] heterogeneous, Hho is computed by substituting the average of distance with the mean vector of all fields, and distance, and the standard deviation of distance for several 4.

[0057] Moreover, the degree FP of [******] shown in several 2 can be defined as shown in several 10.

[0058]

[Equation 10]

$$FP_{i,t}=wf_1 \cdot PC_i + wf_2 \cdot PT_i + wf_3 \cdot PS_{i,t}$$

ただし、

$FP_{i,t}$: 領域iの時間tにおける特徴誘目度
PC_i : 領域iの色の誘目度
PT_i : 領域iの空間周波数の誘目度
$PS_{i,t}$: 領域iの面積の誘目度
wf_i : 重み係数

[0059] In several 10, the degree PC of a color of [**] is explained first.

[0060] the conventional research -- it is and 3 lightness in which the one where 2 saturation in which 1 warm color is conspicuous from cold color is higher is conspicuous is reported for the higher one to be conspicuous. 1) is reported not to be dependent on a background color and for red to be a color with the high degree of [**] by the experiment which **** and others conducted. Based on this result, in this example, it considers as the high hue whose red (0 R, G, B= 255, 0) is the degree of [**] most, and it is assumed that the degree of [**] is high, so that a hue is close to red. When above-mentioned 1992 "an image-analysis handbook" is asked for a hue here using the HSI congruence hexagon-head drill color model indicated by details, a red (0 R, G, B= 255, 0) hue is 0. That is, the point which a HSI congruence hexagon-head drill color model makes BK (black) a zero, and carries out a counter electrode to it is set to W (white). And the straight line which connects BK and W is a center mostly, and the hexagon which makes R (red), M (MAZENDA), B (blue), C (cyanogen), G (green), and Y (Hierro) top-most vertices so that it may intersect perpendicularly with the straight line is formed. Thus, the color space of the formed HSI congruence hexagon-head drill color model is used. In addition, the space of the rectangular three-dimensions system of coordinates used in order that a color space may display a perceived color as one point of space is said. That is, in this example, in order to search for a hue using a HSI congruence hexagon-head drill color model, the degree helium of a hue of [**] becomes large, so that a hue is close to 0. For this reason, the degree helium of a hue of [**] is computed by the formula shown in several 11.

[0061]

[Equation 11]

$$He = 1 - \frac{h}{\pi}$$

ただし、

He： 色相誘目度
h： 領域の平均色相
(但し, h>πの場合はh=π-hとする)

[0062] Moreover, about 2, linearity-relation between saturation and the degree of [**] is. Therefore, in this example, it was presupposed to the degree of saturation of [**] that the saturation in a HSI congruence hexagon-head drill color model itself is used.
[0063] Furthermore, about 3, Semmelroth showed that the relation shown by several 12 was realized in the research on the relation between human being's amount of sensation, and lightness. In addition, the relation shown in several 12 is shown by Daisen, Imai, Wake and others in 1996 "a new edition sensation / perception psychology handbook."
[0064]
[Equation 12]

$$R = S^n + k|S - S_B|^n \qquad S \geqq S_B$$

$$R = S^n - k|S - S_B|^n \qquad S < S_B$$

ただし、

R： 感覚量
S： 視標輝度
S_B： 背景の輝度
k： 定数
m： 視標輝度への反応に対するベキ
n： 視標と背景の輝度差に対するベキ

[0065] Moreover, in several 12, suiting well with human being's amount of sensation in the case of k= 0.65, m= 0.4, and n= 0.2 was shown. Therefore, the formula shown by Semmelroth was made into the degree of lightness of [**] in this example.
[0066] Linear combination of the degree to three elements (a hue, saturation, lightness) of the above colors of [**] is carried out using several 13, and the degree PC of a color of [**] is defined.
[0067]
[Equation 13]

$$\frac{He+S+I}{3}$$

ただし、

He: 色相の誘目度
S： 彩度の誘目度
I： 明度の誘目度(数12のRと同値)

[0068] Next, the degree PT of a texture (spatial frequency) of [**] is explained.
[0069] In human being's visual system, it is shown clearly that it has the property of a band pass machine in which sensitivity serves as max with specific spatial frequency. Until now, Kubota, Nishizawa and others are formulizing visual spatial frequency characteristics like several 14. In addition,

the formula of spatial frequency characteristics is indicated by Kubota and others in 1986/5 "an institute-of-telecommunications-engineers paper magazine" at "the three-dimension noise performance index of a television system, and application to the high-definition television." In addition, the unit of spatial frequency is changed into cpd (the number of cycles per 1 degree of vision) in several 14.

[0070]

[Equation 14]

$$V=(X, Y)=A\cdot\left[1-\frac{1}{1+\left(\frac{X+Y}{0.444}\right)^2}\right]\Big/\left[1+\left(\frac{X+Y}{5\sqrt{d}}\right)^2\right]^2$$

$$A=\left[1+\left(\frac{f_m}{5\sqrt{d}}\right)^2\right]^2\Big/\left[1-\frac{1}{1+\left(\frac{f_m}{0.444}\right)^2}\right]$$

ただし、

V : 視覚反応
X : 水平空間周波数
Y : 垂直空間周波数
A : 視覚反応のピークを1に規格化するための係数
d : 視距離(画面高の倍数)
f_m : ピークとなる空間周波数

[0071] The degree PT of a texture (spatial frequency) of [**] is defined by the vision reaction V shown in this several 14.

[0072] Then, the degree PS of area of [**] is explained.

[0073] It is said that the direction of a near object is conspicuous from the center of an image immediately after generally showing an image, and if a point of regard is moved, the direction of the object near the point of regard which moved is said for the degree of [**] to become high. This is defined as the degree of a field of [**]. Thus, whenever it keeps away from the point focusing on a certain point (point of regard), since it models that the degree of each point of [**] becomes small gradually, the two-dimensional gauss function shown in several 15 is used. However, it is assumed that the center of a gauss function changes according to the time amount which the point of regard moved.

[0074]

[Equation 15]

$$E(x, y, \sigma, t)=\frac{1}{2\pi\sigma^2}\exp^{-\frac{(x-c_x(t))^2+(y-c_y(t))^2}{2\sigma^2}}$$

ただし、

x, y: 画素の座標
cx(t), cy(t) : 中心座標
σ: 広がり係数

[0075] Here, it depends for the breadth coefficient mho of a gauss function on the distance d from a view to an image. That is, if distance d becomes large, the range which can be observed at once will become large. Generally, human being's visible visual field is 20 - 30 degrees. Then, the breadth coefficient mho when setting the screen high of the image shown to H, and making a sight into d-H can be defined like several 16. In addition, Pix is the vertical number of pixels and theta is 20 - 30 degrees ($0.176<\tan\theta/2<0.268$).

[0076]

[Equation 16]

$$\sigma = 2 \cdot Pix \cdot d \cdot \tan \frac{\theta}{2}$$

[0077] Here, if it takes into consideration that it is the set whose field is a pixel, the degree PS of the area of a field of [**] can be expressed by the sum of the degree of the field of the pixel of a field of [**]. Therefore, the degree PS of area of [*] is defined like several 17.
[0078]
[Equation 17]

$$PS_{i,t} = \sum_{x \in RX_i, y \in RY_i} E(x, y, \sigma, t)$$

ただし、

$PS_{i,t}$: 領域iの時間tにおける面積の誘目度
RX_i : 領域iの画素のX座標の集合
RY_i : 領域iの画素のY座標の集合

[0079] Thus, it asks for the drawing field where step S37 estimates the degree of each drawing field of [**], and the degree of [**] serves as max at step S39 by the performance index of the defined degree of [**]. That is, a most conspicuous field is determined as an attention field. Therefore, an attention field as shown in drawing 4 (D) can be extracted.
[0080] In this example, in addition, each coefficient of the performance index of the degree of [**] wh1, wh2, wh3, [wh4] = [0.039, 0.010, 0.027, 0.020], and wf1, wf2 and = [0.132, 0.005, 0.100], and [wf3] [m, n] = [1.358, 4.250] are used. Several 14 theta was made into 20 degrees, and Sight d was set to 1m, and P type Fourier coefficients were carried out to to the 10th order.
[0081] Moreover, although the degree of [**] was evaluated using the eight above-mentioned physical features, this is for making two or more images which have all the features suit, and not necessarily needs to evaluate by this example about no physical features.
[0082] Then, at step S41, it asks for the drawing field contiguous to the determined attention field, the color difference of an attention field and an adjoining-sheets field and the Euclidean distance of a textural facility vector are found, the thing whose color difference is less than 2.0 and whose Euclidean distance of a textural facility vector is less than 0.3 is extracted with an attention field, and processing is ended. In addition, the color difference is CIE as are mentioned above and shows several 5. L* a* b* It asks by the color difference type in perception uniform color space. Moreover, a textural facility vector is searched for according to several 6.
[0083] It returns to drawing 1 and the attention field extracted with the attention field extractor 20 is given to composition cutoff equipment 22. Memory 24 is connected to composition cutoff equipment 22, and two or more data related with the photograph which the picture which the painter drew, and the photographer took in memory 24 is memorized. Composition cutoff equipment 22 cuts out an attention field from a subject-copy image with reference to the data memorized by memory 24 according to the composition of a painter or a photographer. Specifically, composition cutoff equipment 22 cuts off an attention field according to flow drawing shown in drawing 7 . That is, if an attention field and an adjoining drawing field are extracted by the attention field extractor 20, composition cutoff equipment 22 starts processing, will be step S51 and will ask for the periphery pixel of an attention field. That is, it asks for the edge of the extracted attention field. At continuing step S53, by the technique of the paper which above-mentioned Kamisaka indicated, it asks for the P type Fourier coefficients to the 10th order, and an attention field is made into a configuration vector.
[0084] Here, the data memorized by memory 24 is the image data corresponding to criteria images, such as a pictures image and a photograph, the data of the configuration vector which extracted the photographic subject from the pictures image and photograph, and described the periphery configuration of a photographic subject with P type Fourier coefficients, and location data corresponding to the positional information of a photographic subject as shown in drawing 8 . That is, the location data of a

photographic subject is data of the criteria composition of a criteria image. The location of the zero (top-most vertices nearest to the top-most vertices at the upper left of an image) of b and a circumscription rectangle for the length of the side of a and length (w1, h1), [the length of the side beside the circumscription rectangle surrounding a photographic subject] It is expressed with a vector like several 18 when the location (location on the basis of the top-most vertices at the lower right of an image) of the end point (top-most vertices nearest to the top-most vertices at the lower right of an image) of a circumscription rectangle is set to (w2, h2).

[0085]

[Equation 18] Location data [kx1, ky1, kx2, ky2] = [w1 /1 /2 / h2 [a and]/b] [a and h1] [b and w2] Then, the youg lid distance of the configuration vector searched for at step S53 by step S55 and the configuration vector of a pictures image or a photograph stored in memory 24 is found, that is, matching with the data of criteria composition is performed, and the data with which the configuration of a field was most similar at step S57 is acquired. In other words, the location data of the photographic subject of a pictures image with the smallest Euclidean distance is acquired. That is, the optimal image data for an attention field and an adjoining drawing field is chosen from two or more image data. And at step S59, it asks for the circumscription rectangle of an attention field, and some subject-copy images are cut out from the zero and end point of a circumscription rectangle according to several 19. In addition, by several 19, * means multiplication.

[0086]

[Equation 19] Width of face of X1=x1-W*kx1Y1=y1-H*ky1X2=x2+W*kx2Y2=y2+W*ky2, however the circumscription rectangle of an attention field is set to W, and (x1, y1), and an end point are set [height] to (x2, y2) for the zero of H and a circumscription rectangle. Moreover, it considers as the height of a Y2= subject-copy image at the time of the width of face of X2= subject-copy image, and the height of a Y2> subject-copy image at the time of the width of face of Y1=1 and X2> subject-copy image at the time of X1=1 and Y1<1 at the time of X1<1. At this time, the top-most-vertices coordinate of the rectangle (image) to cut off is shown like several 20.

[0087]

[Equation 20] top-most-vertices coordinate =[(X1, Y1) of the image to cut off, (X1, Y2), and (X2, Y1) - -] (X2, Y2)

Then, the result (image) cut off at step S61 is outputted, and processing is ended.

[0088] Therefore, according to the composition of a pictures image as shown in drawing 9 (A), an attention field and an adjoining drawing field as shown in drawing 9 (B) can be cut off.

[0089] Since the field (attention field) which is most conspicuous from a subject-copy image according to the physical feature which was mentioned above is extracted according to this example, the attention field which suited human being's subjectivity can be extracted.

[0090] Moreover, since the extracted attention field is cut off according to the composition of the photograph which the pictures which the painter drew, and a photographer took, a photograph as if it photoed the photographic subject in the composition is generable. That is, the good composition of balance can be determined automatically.

[0091] In addition, since this attention field extractor suits human being's subjectivity and can ask for the degree of an image field of [**], it is applicable to equipment which performs objective evaluation of each field of the image used as the candidate for evaluation, or an image which is conspicuous and performs weighting to that field according to whenever (the degree of [**]), for example in the quality evaluation of a digital compression image and an image.

[0092] Moreover, in the printing field, it is applicable to the equipment which can judge automatically the field which can make light of problems, such as a printing gap, and the field which is not so according to the degree of [**] in automation of quality control. [0093] Furthermore, in the poster work used for the design field, especially an advertisement, it is applicable to the equipment by which it evaluates objective whether it is that the portion against which a company wants to appeal most is conspicuous.

[0094] Moreover, if it controls rotation of a camera, a tilt, and a zoom using an attention field extractor

in being the dress with which a user is conspicuous, a camera can run after a user automatically. A user's snapshot can be taken, if it follows, for example, a shutter is turned off by predetermined timing. Furthermore, the snapshot of the good user of balance can be created by determining composition automatically using composition decision equipment from the photoed image (subject-copy image).

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is illustration drawing showing one example of this invention.
[Drawing 2] It is flow drawing showing a part of processing of the image generation equipment shown in the drawing 1 example.
[Drawing 3] It is illustration drawing showing how to compound a subject-copy image with the image cementation equipment of the drawing 1 example.
[Drawing 4] It is flow drawing showing a part of processing of the attention field extractor shown in the drawing 1 example.
[Drawing 5] It is illustration drawing showing how to extract an attention field according to flow drawing shown in drawing 4 .
[Drawing 6] It is illustration drawing showing the Gabor filter.
[Drawing 7] It is flow drawing showing a part of processing of the composition cutoff equipment shown in the drawing 1 example.
[Drawing 8] It is illustration drawing showing the positional information in the case of cutting off an image according to flow drawing shown in drawing 7 .
[Drawing 9] It is illustration drawing showing pictures image and image referred to and cut off of the painter who refers to when cutting off an image according to flow drawing shown in drawing 7 .
[Description of Notations]
10 -- Automatic Composition Decision Equipment Using Attention Field Extractor
12 -- Camera
14 -- Image Generation Equipment
16 -- Video Capture
18 -- Image Cementation Equipment
20 -- It is Extractor whenever [Attention].
22 -- Composition Cutoff Equipment
24 -- Memory

[Translation done.]

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CLAIMS

[Claim(s)]
[Claim 1] An attention field extractor equipped with an evaluation means to be the attention field extractor which extracts an attention field from a subject-copy image, and to evaluate the degree of [**] based on the physical feature, and an extract means to extract said attention field according to an evaluation result of said evaluation means.
[Claim 2] Said physical feature is an attention field extractor including whenever [of a color / heterogeneous] according to claim 1.
[Claim 3] For said evaluation means, said physical feature is an attention field extractor according to claim 2 by which said degree of [**] is evaluated based on whenever [at least one / heterogeneous] in whenever [four] heterogeneous, including whenever [of a texture whenever / of area / heterogeneous / heterogeneous] further, whenever [formal] heterogeneous.
[Claim 4] Said physical feature is an attention field extractor according to claim 1 to 3 which contains a color further.
[Claim 5] Said physical feature is an attention field extractor according to claim 4 which contains further area and spatial frequency of a field in said subject-copy image.
[Claim 6] An attention field extractor according to claim 1 to 5 further equipped with a photography means to photo a desired image, and an image generation means to generate said subject-copy image based on said image.
[Claim 7] Said image generation means is an attention field extractor including a cementation means to join said image photoed with said camera for every frame according to claim 6, including a driving means to which said photography means carries out the rotation drive of a camera and said camera.
[Claim 8] Automatic composition decision equipment equipped with a maintenance means to hold data about a criteria image which is automatic composition decision equipment using an attention field extractor according to claim 1 to 7, and has criteria composition, and a cutoff means which cuts out an image of an attention field from a subject-copy image with reference to said criteria composition.
[Claim 9] Said maintenance means is automatic composition decision equipment according to claim 8 which holds data about said two or more criteria images, and is further equipped with a selection means to choose said data which suited an image of said attention field.
[Claim 10] Said data is automatic composition decision equipment according to claim 8 or 9 which contains image data corresponding to said criteria image, configuration data of a photographic subject, and location data of a photographic subject at least.

[Translation done.]

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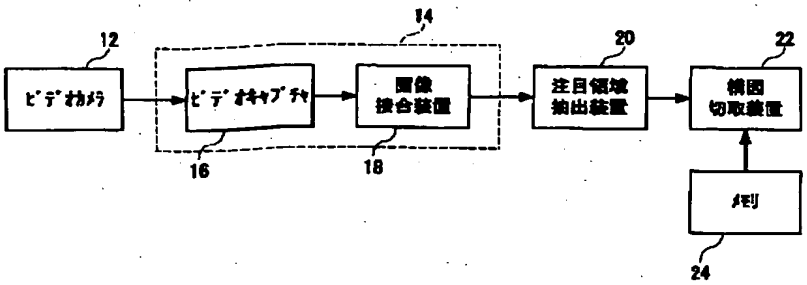
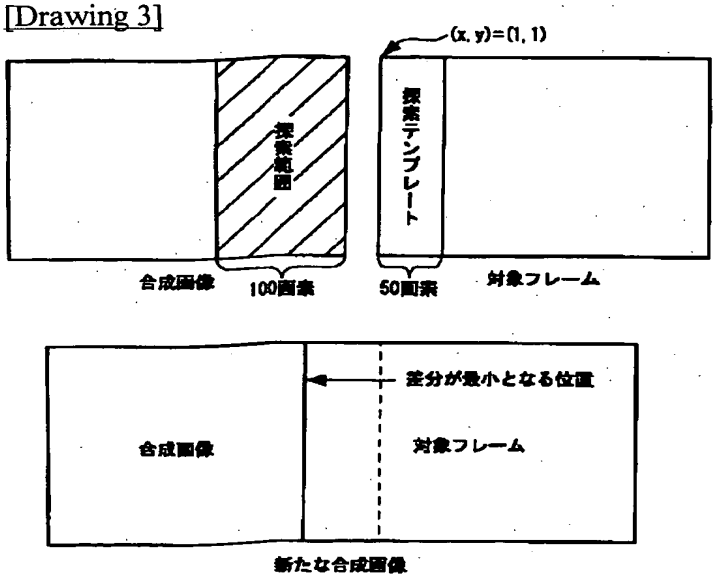
DRAWINGS

[Drawing 1]

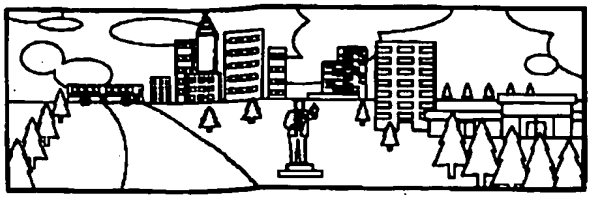


[Drawing 3]



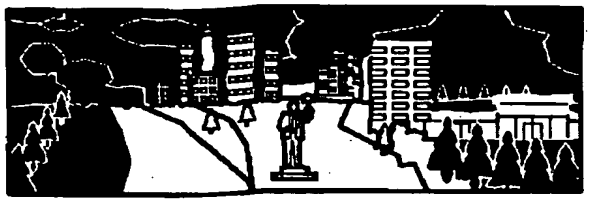
[Drawing 4]

(A)ﾊﾞﾘｴ画像(原画像)



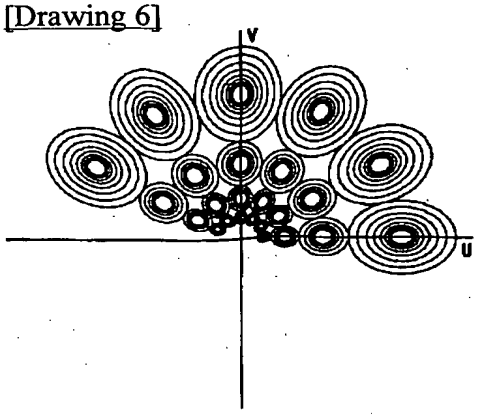
(B)領域分割結果

(C)固領域抽出結果

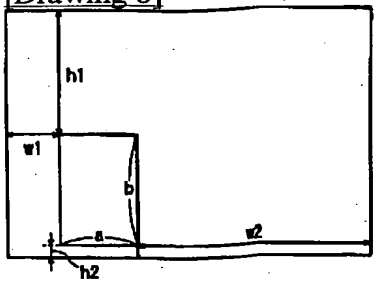


(D)注目領域抽出結果

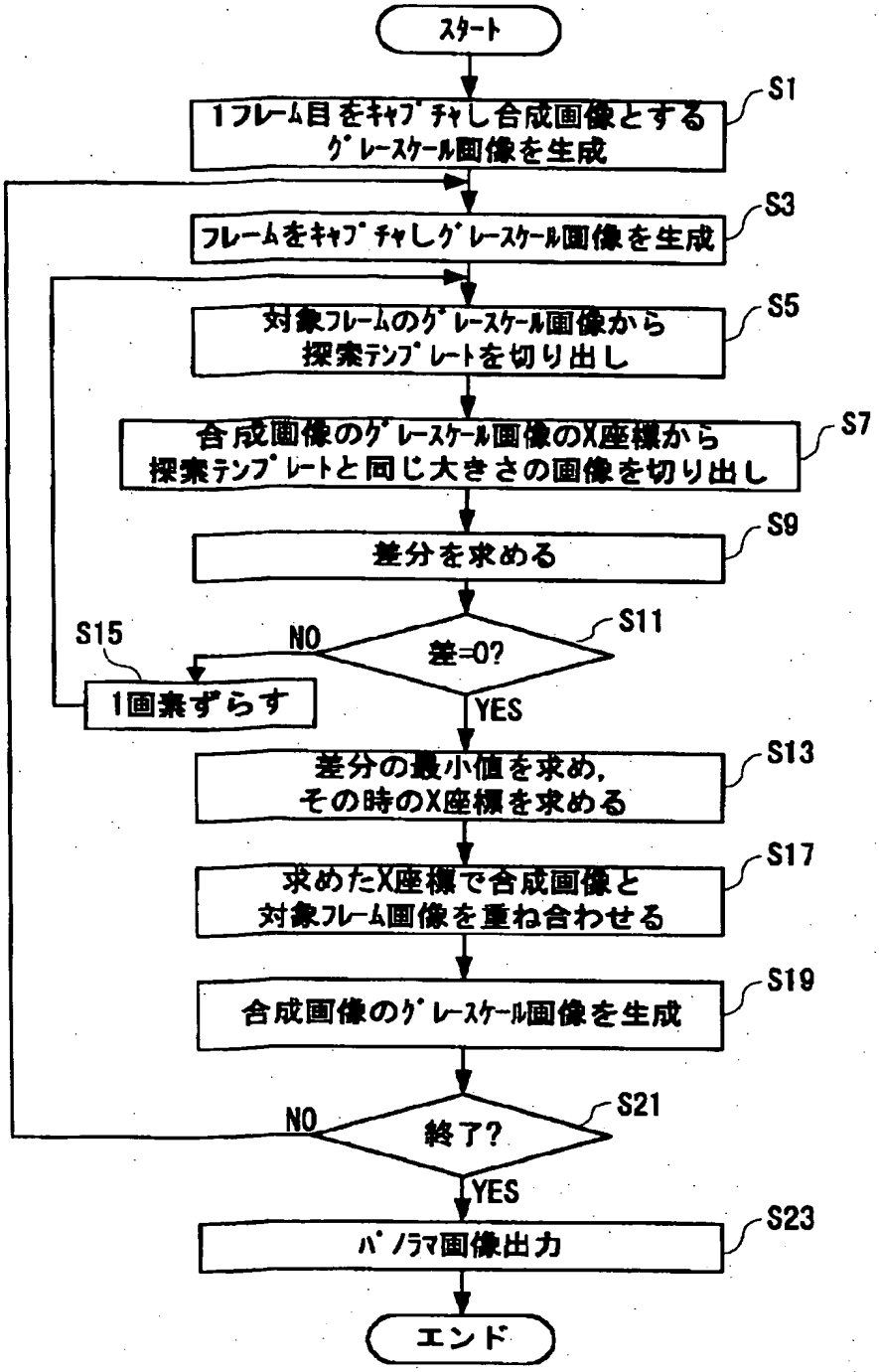
[Drawing 6]



[Drawing 8]

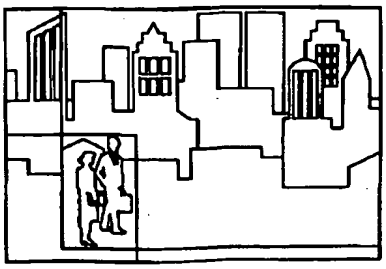


[Drawing 2]

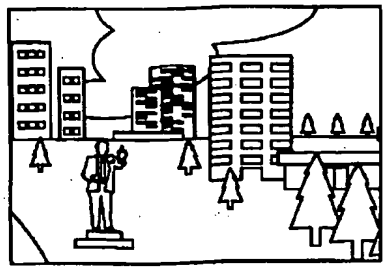

スタート
1フレーム目をキャプチャし合成画像とするグレースケール画像を生成
S1
フレームをキャプチャしグレースケール画像を生成
S3
対象フレームのグレースケール画像から探索テンプレートを切り出し
S5
合成画像のグレースケール画像のX座標から探索テンプレートと同じ大きさの画像を切り出し
S7
差分を求める
S9
差=0?
S11
NO
YES
1画素ずらす
S15
差分の最小値を求め，その時のX座標を求める
S13
求めたX座標で合成画像と対象フレーム画像を重ね合わせる
S17
合成画像のグレースケール画像を生成
S19
終了?
S21
NO
YES
パノラマ画像出力
S23
エンド

[Drawing 9]

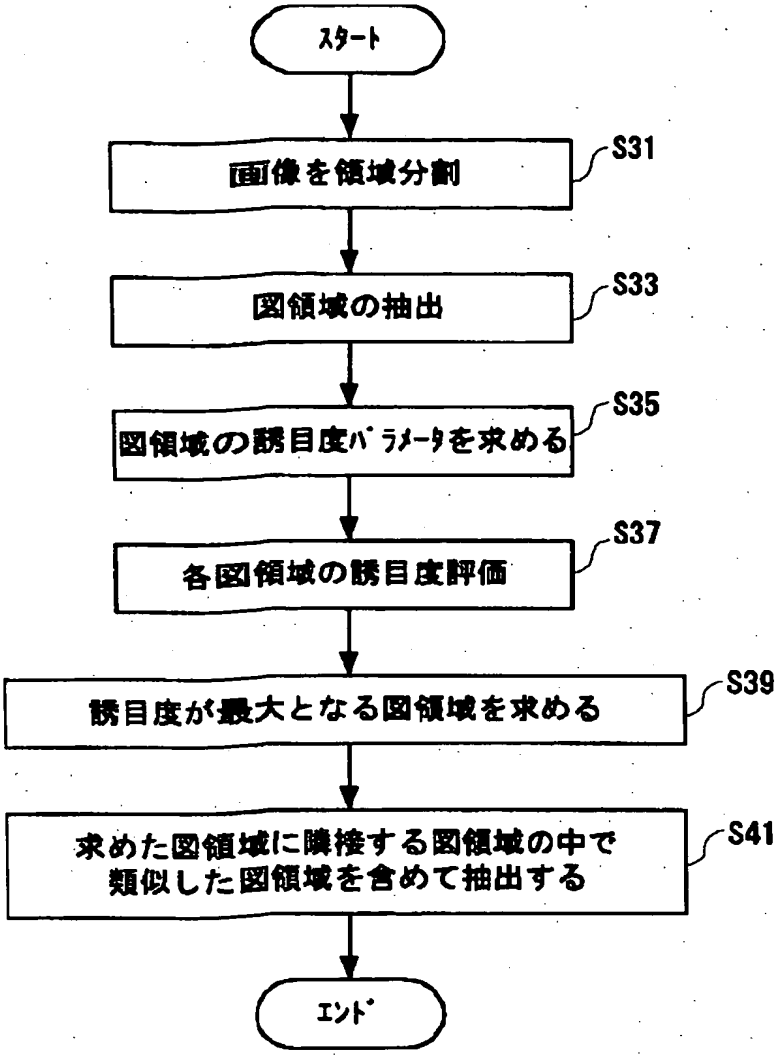
(A)取得した横断情報



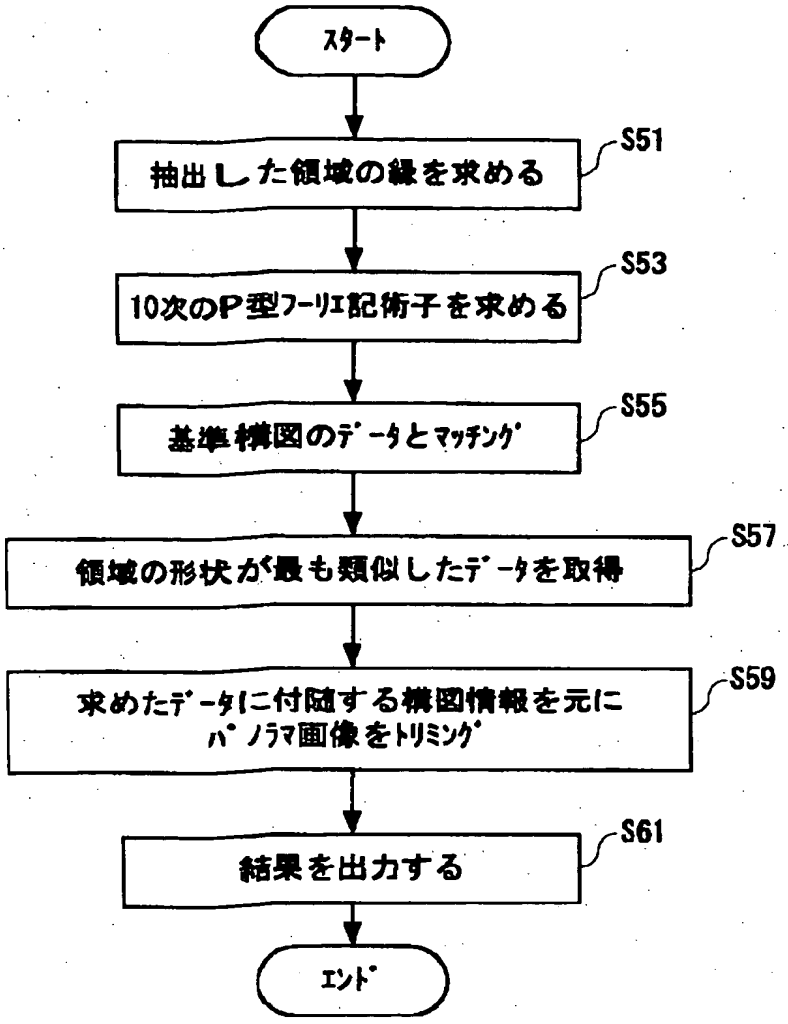
(B)切り取り結果



[Drawing 5]


ｽﾀｰﾄ
画像を領域分割
S31
図領域の抽出
S33
図領域の誘目度ﾊﾟﾗﾒｰﾀを求める
S35
各図領域の誘目度評価
S37
誘目度が最大となる図領域を求める
S39
求めた図領域に隣接する図領域の中で
類似した図領域を含めて抽出する
S41
ｴﾝﾄﾞ

[Drawing 7]



[Translation done.]